

### Modular Universal Adapter – Telemedicine System

The present invention comprises a modular telemedicine system with a universal adapter that connects diagnostic, identification and audiovisual communication function modules, at least one of which is present at the patient location, to a  
5 variable process module that performs data transmission, processing and output. Telemedical treatment of persons is made possible by the connection of the telemedicine system according to the invention to a receiving center located at the doctor's office.

The combination of a universal adapter with individual modules and process  
10 modules that can vary in number and function represents a system that can be implemented in a very flexible manner. In the process, the small physical tolerances of system components – universal adapter, function and process modules – facilitate the mobile application of the telemedicine system.

Reference is made in this invention to the older German patent application by this  
15 inventor entitled "Telemedicine System" (DE 101 54 908.3) for information concerning the configuration of the function modules.

This device is used in situations that require diagnostic testing using medical devices for physicians to make determinations on acutely ill persons, chronically ill patients and healthy patients, said testing having been impossible to do until now  
20 due to the situation or which is possible using the current art only at an unreasonably large degree of technical effort. Such situations include mobile medical treatment of individuals or groups of persons who are out of the country, direct treatment of chronically ill patients at their homes, as well as regular prophylactic self-examination by healthy individuals.

The special design of the universal adapter connection and the correspondingly uniform configuration of the function module connections make it possible to connect any function module to the universal adapter, and thus to the process modules, in exactly the same way. In the process, the universal adapter and 5 function module connections are designed such that they can be intuitively connected correctly even by untrained persons, and that the plugged connection is robust.

Furthermore, the universal adapter is designed such that it allows basic, easy 10 operation of any function module in a uniform manner. The universal adapter reduces the control of different diagnostic devices to a two-knob control system. For all function modules, data recording, transmission and status inquiries can be carried out using two control knobs located on the outside of the universal adapter. Operation is supported by corresponding visual signal elements (LEDs) and 15 acoustic signals as well as a function display to indicate the operating state and to reference the operating steps.

This universal control system provided via the universal adapter provides inexperienced persons the ability to immediately handle a wide variety of function 20 modules/diagnostic devices. Operation or configuration of the universal adapter and function modules can be expanded to include both remote access by the physician's receiving center as well as by corresponding process modules such as PCs or PDAs.

The function modules, at least one of which is present in the telemedicine system 25 according to the invention, are generally hand-held, transportable medical measuring devices used to record diagnostic parameters such as electrophysiological cardiac cycle, blood pressure, body temperature or blood oxygen saturation. The modules are used either by the patients themselves or by

another person present with the patient. Device-specific sensors record the measurements, which are then stored on non-mechanical storage media in the device. All function modules are fully functional individual devices and can be used independent of the remaining components of the system. To enable this, all  
5 function modules have corresponding control elements and signal elements as well as a variable display. Connecting the function module to a corresponding process module – preferably a mobile telephone – by means of the universal adapter allows the data to be transmitted to the physician's receiving center and makes it available to the physician for diagnostic and/or therapeutic decisions. The  
10 entire telemedicine system [function module, universal adapter, process module] is controlled in a simple manner using the universal adapter (Fig. 1)

The following diagnostic function modules are possible candidates for integration into the system: an electrocardiograph, a pulsoximeter, a spirometer, a blood  
15 pressure measurement device, a thermometer, a cardiotocograph, a heart beat monitor [event recorder], a blood sugar measuring device as well as other devices. Other modules are integrated into the system according to connection design requirements.

20 In addition to diagnostic function modules, other types of function modules exist in the telemedicine system. This includes a module for personal identification, for example. It is possible, by means of the module, to authenticate the person doing the transmitting and/or to sign the transmitted data using biometric processes [such as fingerprinting, iris scan] and by reading identification cards. Expanding  
25 the telemedicine system to include such an identification module provides an advantage in comparison to identification mechanisms internal to the device in common use today – such as transmitting the phone number of the communication device or the device ID of the diagnostic function module – in that

the telemedicine system can even be used by groups of persons, there being the ability to assign measured data to individual persons.

Other function module possibilities include the recording of picture, video and audio data. The transfer of these data to the physician's receiving center allows

- 5 the physician to make diagnostic and therapeutic decisions.

The modular construction of the telemedicine system permits flexible usage in various scenarios. The telemedicine system is equipped with function modules according to need. In the process, the medical requirements determine whether

- 10 the system is to contain only a particular diagnostic function module, to monitor blood sugar for instance, or if it is to include all available function modules and thus enable a wide spectrum of diagnostic tests and comfortable audiovisual communication.

- 15 Basically, many different mobile telecommunication devices as well as data processing and output devices [PCs, printers, etc.] can be used as process modules. Thus, a conventional GSM or GPRS mobile telephone can be used for data transmission, as can a UMTS or satellite telephone.

- 20 The exchange of data between the function modules and the universal adapter is done through a hard-wired connection. The corresponding I/O connections on the universal adapter and on the function modules are designed in accordance with a universal standard [such as the USB-2.0 standard]. The transfer protocol used is a standard internet protocol [such as TCP/IP].

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The connection of the universal adapter to the process modules can be hard-wired – using device-specific I/O connections – or wireless [Bluetooth, WLAN].



By integrating appropriate application software into the universal adapter, the system can generate and monitor diagnostic and therapeutic plans. This process must take into account the function modules that are registered, and thus available, in the system. The function modules are automatically registered on the  
5 universal adapter when they are interconnected.

There is a huge advantage to the system according to the invention when simultaneously using more than one telemedicine system in that the universal adapters can communicate with one another. This enables the common usage of  
10 individual process modules, for example. In this case, transmission of data from the universal adapters to the process module is done through a single common transmission path of one universal adapter. Thus, it is also possible to process or transmit numerous diagnostic data from different function modules at the same time using one process module (Fig. 2)

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Below, the individual components of the telemedicine system are described in detail with reference to the sketches.

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Figure 1: shows the basic design of the modular universal adapter - telemedicine system

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Figure 2: shows various application possibilities of the individual system components

Figure 3: shows a detailed schematic design of the universal adapter and the function module

The telemedicine system according to the invention 10 has a modular design. In essence, it comprises three components, a function module 40, a universal adapter 20, and a process module 60. The telemedicine system 10 can connect to a physician's receiving center 80 via a wireless transmission path 90 with the aid of corresponding process modules 60 (Fig. 1)

The function module 40 is a module of varying function and number that represents either a medical diagnostic module that records specific diagnostic parameters, an identification module for personal identification, or an audiovisual communication module.

Medical diagnostic modules can include an electrocardiograph, a pulsoximeter, a spirometer, a blood pressure measurement device, a thermometer, a cardiotocograph, a heart beat monitor [event recorder], a blood sugar measuring device or other devices.

All function modules are identified through common technical features. Thus, all devices have identical connections 42/44 for the universal adapter 20. The bi-functional connection enables charging of the module's internal battery as well as hard-wired data transfer. Control elements 56 are located on the outside of the module to allow measurement operations. In addition, all function modules 40 have displays 58 that vary in shape and size to display measurements and/or to check function. The diagnostic function modules contain corresponding sensors 48 to measure the diagnostic parameters. If the function module is designed as an identification module, it has a reader that reads biometric identification features [fingerprint, iris] or identification cards.

Another type of function module 40 equipped with sensors to record acoustic and video signals and with a large color display and loudspeaker enables audiovisual communication.

- 5    The universal adapter 20 contains a universal I/O connection 22/24 [for example USB-2.0 standard] for the function modules 40, through which the data is transferred hard-wired and the battery of the function modules 40 is charged. Data is exchanged with the process module 60 via a wireless connection [for example Bluetooth, WLAN]. Use of the module is supported by control elements
- 10   36 and function displays 38 on the outside of the module. Furthermore, the universal adapter 20 has its own battery 26 so that it can be operated independent of network power. The batteries of the universal adapter 20 and function modules 40 are charged using a charging cable 27 connected to the universal adapter 20.
- 15   The different application possibilities of the system derive from the modular design of the telemedicine system 10. Thus, it is possible to use the function modules 40 directly [Fig. 2a], or to connect all function modules 40 sequentially to the universal adapter 20 and to operate them by means of the universal adapter 20 in an identical manner [Fig. 2b]. Such operation includes mainly basic operating steps, such as data recording, data transmission and status inquiries. Furthermore, the
- 20   use of the modular universal adapter - telemedicine system as such includes the wireless or hard-wired connection of the universal adapter 20 to a process module 60 [Fig. 2c, d]. This permits the connection to the physician's receiving center 80 over transmission path 90 to be accomplished using suitable process modules.
- 25   Moreover, wireless communications of universal adapters 20 with one another permits common usage of individual process modules 60 that are present [Fig. 2e].



## Parts List

- 10    Telemedicine system
- 20    Universal adapter
- 22    I/O connection (for example USB)
- 5    24    Power connection (for example USB)
- 26    Battery
- 27    Charging cable
- 28    Wireless interface (WLAN/Bluetooth)
- 30    Central processor
- 10    36    Control elements
- 38    Function display
- 40    Function module
- 42    I/O connection (for example USB)
- 44    Power connection (USB)
- 15    46    Battery
- 48    Measurement sensor
- 50    Central processor
- 56    Control elements
- 58    Display
- 20    60    Process module
- 80    Receiving center
- 90    Transmission path